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ABSTRACT

This case study presents an intervention by university researchers, serving in the role of participant-observers, for the purpose of improving science education at a rural, economically disadvantaged elementary school. Interest in improving the school's science program stemmed from conversations between the principal and the two researchers. The principal was pleased that a number of instructional improvements were occurring at the school, but was disappointed with the quality of instruction in science. Owing to the university's commitment of service to the public schools in the state, the researchers accepted the challenge to assist in improving the school's science education program by working with the principal to solicit help from private corporations, and to collect baseline data through involving the school's stakeholders (teachers, students, and parents) in the process. (Author/WRM)

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# IMPROVING SCIENCE EDUCATION AT AN ECONOMICALLY DISADVANTAGED RURAL ELEMENTARY SCHOOL

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Abstract: This case study presents an intervention by university researchers, serving in the role of participant-observers, for the purpose of improving science education at a rural, economically disadvantaged elementary school. Interest in improving the school's science program stemmed from conversations between the principal and the two researchers. The principal was pleased that a number of instructional improvements were occurring at her school, but disappointed with the quality of instruction in science. Owing to the university's commitment of service to the public schools in the state, we accepted the challenge to assist in improving the school's science education program by working with the principal to solicit help from private corporations, and to collect baseline data through involving the school's stakeholders (teachers, students and parents) in the process.

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The case study presented in this paper focuses on Part 1 (March through November of 1998) of our efforts as university researchers serving in the role of participant-observers to assist the principal of an economically disadvantaged K-6 elementary school to improve science education. The school, one of three in the district, serves an enrollment of approximately 600 students and is located in a small rural city in northeastern Mississippi which was once a regional cotton market. According to 1990 census data, the city's population was 3,267 (50 percent Black, 49 percent white, and 1 percent other minorities) with the average personal per capita income being $8,262.

The school's main building was built in 1924 and originally accommodated a high school program. Additional buildings were added through the years and the site was converted for use as an elementary school in 1970. The school's organizational structure for teaching and learning may best be described as a self-contained classroom approach with some departmentalized teaching in the upper grades.

Interest in improving the science education program at the school resulted from conversations with the principal who was disappointed with the quality of the science program. In keeping with Mississippi State University's commitment of service to the state's public schools, we accepted the challenge of helping the principal improve the science program.

Improving Science Education: Step 1

The first step to improve the teaching of science at the school was taken in the early spring of 1998 and pertained to helping the principal explore whether any company producing science curricula materials was interested in becoming involved in the project. The Director of Marketing for the Carolina Biological Supply Company of Burlington, North Carolina said he was interested in working with us to pilot their innovative hands-on science program at the school. The program, titled Science and Technology for Children (STC), emphasizes hands-on learning through inquiry and discovery.

Encouraging learning by doing, STC units capture children's natural curiosity and stimulate their interest in learning about science. Students participate in a variety of exciting activities involving observation, measurement, identification of properties, and controlled experiments involving life, earth, and physical science concepts.

Every STC unit consists of a comprehensive package containing everything a teacher needs to cover a key science topic in eight weeks. Unit components include a teacher's guide, student activity books, equipment, and materials. STC designers paid careful attention to the diverse learning styles and the developmental readiness of children in developing the units. Complete preparation steps help teachers to plan and implement each lesson.

Improving Science Education: Step 2

Secondly, the attitudes of the school's teachers, students, and parents toward science education were investigated in the late spring of 1998 for the purpose of collecting baseline data. We worked with the principal to develop three brief instruments, one each for teachers, students, and parents.

The teacher instrument asked respondents to mark each of four statements either "Agree," "Unsure," or "Disagree." The four statements were:

1. I am very interested in teaching science.
2. I enjoy teaching about science.
3. Learning about science has helped my students to better understand how the world works.
4. Learning about science this year has caused my students to want to learn more about this very interesting subject.

Teachers were also given opportunity to make comments.

Results of the teacher survey are presented in Table 1 by the number and percent of teachers stating a particular response. Percentages are set off by parentheses. The table also presents values for chi-square statistical tests used to determine if there were significant differences between observed and expected frequencies. An asterisk indicates that the response was statistically significant at the .O1 alpha level.

Table 1. Teachers' Attitudes Toward Teaching Science

| | Agree | | Unsure | | Disagree | | Chi Sq |
|---|---|---|---|---|---|---|---|
| | Num | % | Num | % | Num | % | |
| 1. Interested in teaching science. | 6 | (29) | 7 | (33) | 8 | (38) | .29 |
| 2. Enjoy teaching science. | 6 | (29) | 8 | (38) | 7 | (33) | .76 |
| 3. Science has helped my students to better understand how the world works. | 6 | (29) | 8 | (38) | 7 | (33) | .29 |
| 4. Learning about science this year has caused my students to want to learn more about this very interesting subject. | 5 | (24) | 8 | (38) | 8 | (38) | .90 |

(df = 2, n = 21)

The findings presented in Table 1 indicate that the teachers at the school are almost evenly divided in their opinions whether they are interested in teaching science, enjoy teaching science, science has helped their students understand how the world works, or if their students want to learn more about science. Less than one-third of the teachers stated positive opinions. None of the responses were statistically significant. Approximately one-third of the teachers made comments. Sample comments follow:

*Science is almost a forgotten subject (at our school).*
*Science just doesn't interest me.*
*I feel that this school does not have the equipment necessary to teach science in an exciting way.*
*To me, science has to have a lot of hands-on things to be taught properly.*
*The majority of my students do not like science.*

For the most part, the teachers' comments were negative.

The student instrument asked respondents to mark each of four statements either "Agree," "Unsure," or "Disagree." The four statements were:

1. I am very interested in learning about science.
2. I enjoy learning about science.
3. Learning about science has helped me to better understand how the world works.
4. Learning about science this year has caused me to want to learn more about this very interesting subject.

Students were also given opportunity to make comments.

Student survey results are presented in Table 2 by the number and percent of students stating a particular response. Percentages are set off by parentheses. The table also presents values for chi-square statistical tests used to determine if there were significant differences between observed and expected frequencies. An asterisk indicates that the response was statistical significant at the .O1 alpha level.

Table 2. Students' Attitudes Toward Learning Science

| | Agree | | Unsure | | Disagree | | Chi Sq |
|---|---|---|---|---|---|---|---|
| | Num | % | Num | % | Num | % | |
| 1. Interested in learning science. | 175 | (45) | 127 | (33) | 84 | (22) | 32.40* |
| 2. Enjoy learning about science. | 168 | (45) | 114 | (31) | 91 | (24) | 24.73* |
| 3. Science has helped me to better understand how the world works. | 155 | (42) | 120 | (33) | 94 | (25) | 19.23* |
| 4. Learning about science this year has caused me to want to learn more about this very interesting subject. | 175 | (47) | 105 | (28) | 94 | (25) | 28.05* |

(df = 2, n = 386)

The findings presented in Table 2 indicate that slightly less than half of the students stated they were interested in learning science, enjoyed learning about science, have been helped to understand how the world works, and want to learn more about science. The majority of the students were either unsure or negative in their responses. Students' responses, however, were statistically significant and should be considered positive. Less than 10 percent of the students made comments. Sample comments follow:

*Science is the best subject.*
*I like science because it helps me learn more about the weather.*
*I like science because I like learning about the world.*
*I don't think science is fun it's boring.*
*I want to learn more about science.*

Students' comments were mostly positive.

The parent instrument asked respondents to mark each of four statements either "Agree," "Unsure," or "Disagree." The four statements were:

1. My child is very interested in learning about science.
2. My child enjoys learning about science.
3. Learning about science has helped my child to better understand how the world works.
4. Learning about science this year has caused my child to want to learn more about this very interesting subject.

Parents were also given opportunity to make comments.

Parent survey results are presented in Table 3 by the number and percent of parents stating a particular attitude toward their children learning science. Percentages are set off by parentheses. The table also presents values for chi-square statistical tests used to determine if there were significant differences between observed and expected frequencies. An asterisk indicates that the response was statistical significant at the .O1 alpha level.

Table 3. Parents' Attitudes Toward Their Children Learning Science

| | Agree | | Unsure | | Disagree | | Chi Sq |
|---|---|---|---|---|---|---|---|
| | Num | % | Num | % | Num | % | |
| 1. Interested in learning science. | 29 | (35) | 23 | (28) | 31 | (37) | 1.33 |
| 2. Enjoy learning about science. | 28 | (36) | 24 | (31) | 25 | (33) | .48 |
| 3. Science has helped my child to better understand how the world works. | 29 | (36) | 23 | (28) | 29 | (36) | .77 |
| 4. Learning about science this year has caused my child to want to learn more about this very interesting subject. | 30 | (37) | 21 | (26) | 30 | (37) | 2.76 |

(df = 2, n = 83)

The findings presented in Table 3 indicate that parents are almost evenly divided in regard to whether their children are interested in learning science, enjoy learning it, understand how the world works, and want to learn more about the subject. None of the responses were statistically significant. Also, none of the parents made written comments.

In summary, the responses of teachers and parents toward the teaching and learning of science at the school were either uncertain or negative. Teachers appeared not interested in teaching science, didn't enjoy doing it, didn't believe that science helps students understand the world works, or students wanted to learn more about the subject. Likewise, parents didn't think their children were interested in science, didn't enjoyed it, weren't helped to understand how the world works, or wanted to learn more about the subject. Students, on the other hand, were more positive in their opinions. Findings showed they were interested in science, enjoyed it, believed learning about science helped them understand how the world works, and wanted to learn more. Chi-square statistical testing indicated that the students' responses were significant; that is, more positive than predicted by chance.

Improving Science Education: Step 3

Step three pertained to implementing the STC program. The Carolina Biological Supply Company provided STC units for approximately 500 children enrolled in grades 1-6. After receiving training from the company, we conducted a staff development workshop on September 8, 1998 to explain the program to the teachers.

Using hands-on science in the elementary classroom requires change on the part of both teachers and students. They both must come to see themselves as mutual participants in the learning process. Teachers become more than transmitters of knowledge, while students become more than receivers of knowledge.

In the traditional approach (often referred to as textbook science), the focus is on discrete bits of information meted out in preordained doses. Activities serve as tools for students in obtaining the meted out doses of preordained knowledge.

Hands-on science differs from traditional methods of science instruction by changing the focus. Students solve problems and explore materials without being given step-by-step directions. The teacher:

1. Serves as a knowledgeable resource and must be knowledgeable about science facts and concepts.

2. Sets up experiences to encourage exploration and discovery in the learning environment.

3. Uses students' questions and observations as a springboard for discussion and application of acquired knowledge.

4. Pulls the lesson together so that ideas generated are focused and productive.

Recall, prediction, and reflection are given equal attention. Students are asked to recall previously acquired knowledge prior to the day's lesson, predict what will occur, and reflect on what they already know.

Implementing the new science education program proved more difficult than anticipated because of the staff's involvement in a very demanding schoolwide reading program called Success for All (SFA), which was developed by Robert Slavin and others at Johns Hopkins University. The school day began with a 90-minute block devoted to the SFA reading program, and approximately 50% of the students were pulled from afternoon schedules for one-on-one 20-minute tutoring sessions.

In addition, the district was on probation for low standardized test scores and closely monitored in relation to teaching basic skills by the Mississippi Department of Education. Pressure was on administrators, teachers, and students to increase test scores. The Iowa Test of Basic Skills (ITBS) is administered in the fall and tests the areas of reading, language arts, and mathematics. These areas, therefore, received more emphasis that those areas, such as science, not tested.

Preliminary classroom observation conducted in the late fall indicated that the new science education program was proceeding with some difficulty. Even though every unit consists of a comprehensive package containing everything a teacher needs to cover a key science topic, organizing the materials for a class of 25 to 30 students can be tedious and time-consuming. The school's schedule afforded a 30-minute daily period for science, but teachers sometimes used this time slot to emphasize basic skills and information that would likely appear on norm-referenced tests. Preparation time for hands-on science was not built into the

schedule and was done at the beginning of the class. In fifth and sixth grade departmentalized classes, student helpers played key roles in setting up and putting away unit components such as activity books, equipment, and materials. Student helpers were observed less frequently in the self-contained first through fourth-grade classrooms.

Reflecting on the Intervention

This case study focused on Part 1 (March through December of 1998) on our efforts to assist the principal of a rural, economically disadvantaged elementary school in becoming an instructional leader for the purpose of improving science education at her school. The first three steps in the intervention process involved:

1. Identifying and securing resources by establishing a partnership with the Carolina Biological Supply Company who contributed expertise and over $10,000 worth of books, equipment, and materials.

2. Collecting baseline data regarding teacher, student, and parent attitudes toward the teaching and learning of science.

3. Implementing the program. Implementation took place in the late fall despite the staff's preoccupation with following a prescriptive state-mandated school improvement plan emphasizing basics skills.

What have we discovered from the intervention so far? First, children instinctively like learning science because of their natural curiosity. Secondly, the STC approach to teaching science works in difficult circumstances because every unit consists of a comprehensive package containing everything a teacher needs--teacher's guide, student activity books, equipment, and materials--to cover a key science topic. Complete preparation steps helped teachers to plan and implement the lessons.

Classroom observations of the STC program in operation during the 1998-99 school year and the attitudes of teachers, students, and parents toward the new hands-on science program will be presented in a latter paper.

To learn more about how principals and teachers, with the assistance of their university colleagues, can *actually* improve science education from within a school, anecdotal cases, such as the one presented in this paper, are needed for the continued development of the "best practice"

literature base addressing science instruction. The findings presented in this case study make a meaningful contribution to that literature base.

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